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CH-630

REPORT NO. 6

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Report CH-630

Metallurgical Project

A. H. Compton, Project Director

* * *

HEALTH, RADIATION, AND PROTECTION

R. S. Stone, M.D., Division Director

* * *

REPORT FOR MONTH ENDING MAY 7, 1943

* * *

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A. GENERAL SUMMARY

R. S. Stone, Division Chief

A. Physics

The monitoring of radiation hazards at Site X has been set up as follows:

I. Personnel

(a) Pocket radiation meters on every one entering the grounds of the Clinton Laboratories.

(b) Integrating recording meters and rate recording meters at fixed locations in the various buildings and around the grounds.

(c) Survey meters to be taken for rapid checking to any point of suspected high intensity.

II. The Public

(a) Pocket Radiation meters on guards patrolling the boundaries of Site X as a whole.

(b) Fixed integrating recording meters in the village and at Clinton.

(c) Surveys with high intensity survey meters at various points in and around the reservation under various weather conditions.

(d) Measuring instruments on the exhaust air from the Pile and from the Extraction Plant.

(e) Sampling of the water at various points before it is turned into the river.

Several instruments have been tested, especially modified "integrons" and pocket chambers. A modification of the pocket condenser chamber has been made so as to read beta-ray doses.

The radiations from masses of X-metal have been measured. The x-ray intensity creates no hazard but the penetrating beta-rays are sufficiently numerous to be a hazard to the hands of anyone handling the metal for protracted periods.

Measurements of x-rays through a narrow staggered channel were made to check on effectiveness of various offsets for plugs in the radiation shield.

B. Biology

Since radioxenon is not available radioargon has been used with guinea pigs, with inconclusive results to date.

The "neutron unit" being used here has been checked with Berkeley

[redacted]

instruments and found to be the same "physical" unit as that used at the Radiation Laboratory in Berkeley. The Drosophila egg survival curves have been found to differ from those found at Berkeley and Ann Arbor.

The rabbit "survival curves" and early estimates of the hematological changes in rabbits indicate an X/N ratio of 7.

Calculations show that the "tolerance" concentration of I^{131} in air which is breathed for 8 hr/day is 2.5×10^{-13} curies /cm^3. Formulae for calculating the radiation dosage in tissues from inhaled or ingested fission activities are given.

C. Clinical

Three workers showed blood changes due to over-exposures to radiation.

A n avoidable ether explosion damaged three workers.

The air in some cooperating plants has been found to have dangerous concentrations of metal dust.

The work at the associated and sub-contract centers has continued, (except M.H. in New York) along the lines previously followed but no new results are reported.

Dr. Church of the Meteorological Division has made a separate report (CH-563).

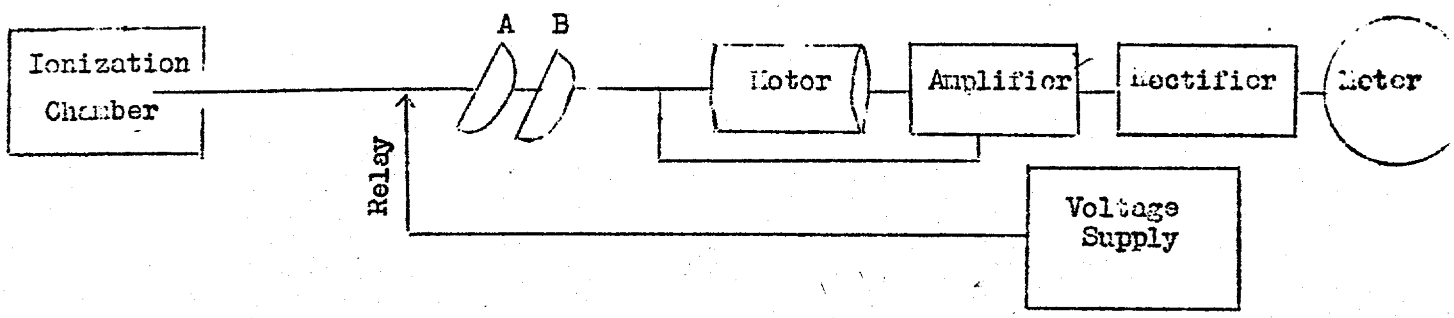
A. HEALTH PHYSICS
E. O. Wollan - Section Chief

1. Radiation Monitoring and Instrument Coordinating Committee.

The Committee has been meeting regularly since its formation and has recommended to M.D.Whitaker, through the Health Division, a plan for monitoring radiation at X. This plan included a statement of the number and types of instruments, their approximate location with respect to operating units and about the area as a whole. A plan for sampling the water at various points before returning it to the river has also been given. Orders have been placed for the most of the required instruments. Some of these instruments are being developed and constructed here, the majority are, however, being acquired from outside concerns. One of the largest instrument items is the pocket radiation meter. These are being ordered in a sufficient quantity to furnish them to the entire personnel at X. An air conditioned room will be set aside or a small house built near the entrance gate in which these meters will be charged and read, recorded and kept in repair. These pocket meters in addition to being used in checking the radiation received by the wearer will be used in guard houses or on guards patrolling the boundary of the Site to give a continuous record of the activity of the air which moves out of the area. In populated areas it is planned to supplement the records received from these pocket meters with continuous recording units.

Survey meters for the rapid checking of the Activity at any desired point will be available in two types; (1) the vacuum tube amplifier type made by Victoreen, which reads the intensity directly on a meter and has a sensitivity of 0 to 0.1 r/hour for full scale deflection, (2) the Lauritsen electroscope is being made up by Fred C. Hensen in the form of a portable instrument. With this instrument intensity is determined by measuring the rate of drift of the quartz fibre. This instrument has a much higher sensitivity than the direct reading type, and from our point of view it is generally more satisfactory. For operating personnel the feeling seems to be in favor of the direct reading type.

Several recording instruments for gamma-ray measurements will be used near the pile and the extracting plant. One of these instruments is a modification of an instrument made by Victoreen, known as the Integron, which has been in use in x-ray therapy for several years. For the x-ray work it has a small thimble chamber of about 0.5 cc volume and it integrates a dose up to 300 r. After a dose in this range is delivered a relay shuts off the x-ray machine and rings a buzzer. By increasing the chamber volume to 1500 cc, the full scale on the meter is brought down to 0.1 r. When operated with a recorder the slope of the line drawn is a measure of the intensity and the total deflection gives the total radiation received. By adding a clock which charges the system every 8 hours, the meter never reaches the limit of the scale unless the dose is greater than 0.1 r/8 hours. If the meter does reach the limit and hence indicates too high a radiation level an alarm can be set off if desired, and the instrument reset automatically. This meter has a very high upper limit of range because it can go through the 0.1 r cycle very rapidly. The instrument is of the A.C. amplifier type and for this reason it should not have much zero drift. The principle of the unit is shown in the accompanying sketch.



The central system of the ionization chamber is attached to one set of plates of a well insulated condenser and this system is charged up by the relay. The other set of plates is attached to and insulated from the shaft of a motor. The rotating plates have an alternating potential induced on them which is proportional to the charge on the ionization chamber electrode. This alternating potential is amplifid, rectified and read on the meter. As the potential on the chamber electrode leaks off the meter reading changes.

One of these instruments is now being tested and so far has operated in a very stable manner.

This Committee is now engaged in drawing up a plan for monitoring at Site W. A more complete report of the Committee's recommendations will be made later.

2. Project Handbook

Work is in progress on the Health Protection chapter of the project handbook, with Drs. Cantril and Cole. It is expected that this will be finished by June 15.

3. Training Program

The five lectures scheduled on the physics of radiation protection, given to duPont trainees will be completed on May 10.

Mr. W.M.Porter spent three weeks working in this section under Mr. Parker as a helper and trainee and now Mr. J.Q.duPont is with us in the same capacity.

4. Radiation Hazards from X-Metal - H. M. Parker

Parker has worked out some general propositions for the estimation of gamma-radiation from any configuration of metal. Parker and Gamertsfelder have worked on the beta- and alpha-ray aspects. This data will be collected in a report to be published this month. The general conclusions are:

(1) The maximum dosage rate from the gamma radiation arising from a single flat wall of metal is 0.04 ($\pm$ .01)r/ 8hr.day.

(2) Maximum dosage rate under worst possible conditions (e.g. complete room) is 0.08 ($\pm$.02)r/8 hr. day.

(3) The beta radiation from stored metal is adequately removed by keeping metal in wooden boxes 3/4" thick.

(4) Handling of bare metal can give $\sim$ 0.25 r/hour if the soft component of beta-radiation is included. Accepting 10 mg/cm^2 as a reasonable thickness for the skin layer of "passive absorption" (See Parker's report on βeta-ray effects in press), the effective radiation is reduced to $\sim$0.09 r/ hour.

(5) The protective value of gloves is possibly overrated in this case. The regular canvas gloves reduce the exposure by 6 - 10%; leather gloves by about 25%.

5. Tolerance Dose

The report on tolerance dose being written with Dr. S.T.Cantril is completed and will appear soon as a separate report.

6. Beta Ray Chambers - Parker and Ganertsfelder

Beta ray-chambers have been made to the dimensions of the present aluminum chambers by -

(1) turning down the wall to suitable thickness,

(2) replacing the central portion by a cylinder with aluminum foil,

(3) using metal screen.

The foil thickness ranged from 2.17 mg Al/cm^2 on up. The thinnest was fragile, but beyond 5 mg Al/cm^2 the tubes were surprisingly sturdy. Any of the chambers could be worn ouside the clothing inside a protective cage. The chambers have so far been used to study the exposure to Beta-radiation from X-metal, etc., and to measure secondary beta-radiations produced by gamma-ray sources in the laboratory.

a. Victoreen Pocket Chambers.

We have previously shown that the Victoreen pocket chambers used with the Minometer have linear scale up to 0.05 r after which the reading falls below the time value by an amount increasing to 10% at full scale. In a recent conference with Mr. Victoreen he indicated that this result was unlikely unless the exposures were made at a rate higher then that recommended by him (~ 10 minutes), the curve has been repeated with exposure time up to 3 hours. The same deviation from linearity has been obtained in all cases.

b. Other Pocket Chambers

1. A group of 12 chambers was returned from an outside source after 2 months use. Only 3 of these were in good condition. The exposure data collected by such groups will be meaningless(except as a safeguard against gross over-exposure) until the recording is done by competent men.

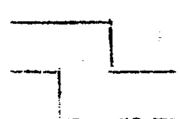
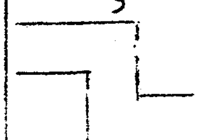
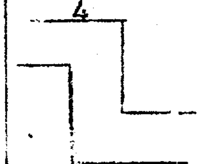
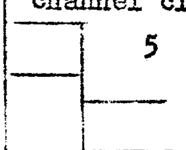
2. A new set of chambers has been made up with bakelite wall instead of aluminum, partly because aluminum was no longer available and partly to take advantage of the improved wavelength effect. These chambers will require a carbon coating and a metal stud connecting the inside surface with the outside.

3. A sample of conducting rubber was sent to us by Messrs. duPont. This has been made into a chamber. Its conduction is less than that of untempered bakelite.

7. Measurement of Radiation Through a Narrow Staggered Channel -C.Gamertsfelder

In the plugging of holes in a pile shield or the bringing of leads through the extraction plant shield it may be necessary to have one or more steps or bends to reduce the radiation leakage to a safe level. The following experiment was performed to check the radiation leakage through a channel in a lead shield as a function of the size of the offset step. The set up consisted of a channel 1/ 4" x 3/4" in cross section and 16" long built with lead bricks and spacers. A 2 gm Radium source was placed at one end of the channel, the source being shielded on the other sides by several inches of lead. Measurements of the intensity of the open end of the channel were made with a Lauritsen electroscope for different offset steps. For the open channel, the intensity was found to be too high to get saturation in the chamber so these measurements were made with a lead absorber between the source and the chamber and the intensity for no absorber was calculated from absorption data.

The following table gives the results of the measurements after making background corrections.

	1	¼"offset 2	3/8"offset 3	½" offset 4	3/8"offset channel closed 5
Nature of channel 1/4" x 3/4" x 16"					
Relative Energy through Channel	1	.42	.0081	.0019	.0069
Lead thickness for equivalent energy reduction	0	1.8 cm	9.2 cm	12.2 cm	9.5 cm

The fact that the reduction by the arrangements in columns 3 and 5 are nearly equal indicates that scattering plays a negligible role and the radiation passes through the lead of the steps.

C. BIOLOGICAL RESEARCH

K. S. Cole, Section Chief

8. Xenon and Argon Experiments

Active xenon has not been available for experiments during the past month, and only control guinea pigs have been maintained in the closed animal houses. Animals kept in the bottles from two weeks to a month were autopsied and found to be grossly normal. Reports on microscopic sections not yet available.

It will be necessary to work out a procedure for recovering and concentrating Xe^{133} at Site X. 2 mC of Xe^{133} isolated from the latest St. Louis bombardment are being used for the development of these procedures.

To obtain information on the pathological effect of a beta-emitting gas and on the concentrations necessary to produce acute effects, an attempt was made to use active argon (A^{41}). This isotope is produced by deuteron bombardment of A^{40}. It decays by emission of a 1.5 MeV Beta and a 1.37 MeV gamma. (Although these energeries are much higher than the corresponding ones for Xe^{133}, the effects should be qualitatively similar). The half-life is short, 110 minutes.

To date two animals have been exposed to A^{41}. Pig #24 was placed in a bottle with an initial A^{41} concentration of 5.3×10^{-6} curie/cm^3 and removed 14 hours later for observation. The animal was apparently normal when killed and autopsied after one week. Lateral surface of lungs showed some consolidation. Microscopic sections not yet available.

Pig #28 had A^{41} added to his atmosphere on 3 successive evenings, the initial concentrations being 5.3, 4.2, and 7.4×10^{-6} curie/cm^3. For several days after the third exposure the animal was ill but recovered. On the fifth day after exposure, it was killed and autopsied. Grossly normal except for lung consolidation in the right hilar region. No report as yet on microscopic sections.

One further attempt is being carried out to give an animal still more A^{41}. The chance for extensive lung damage resulting is probably small, however, since an initial concentration of 5.3×10^{-6} curie/cm3 gives the animal a total lung dose approximately 1 r.

9. Fast Neutron and X-ray Experiments - R.E.Zirkle and L.O.Jacobson.

a. Standardization of Ionization Chambers.

Through the courtesy of Dr. Paul C. Aebersold of the Crocker Radiation Laboratory, University of California, we have obtained the loan of the Victoreen condenser r-meter and the special 100-r chamber which have been used in all of the fast neutron radiobiology and clinical radiology at Berkeley, including the early work on Drosophila eggs and the work of J.H.Lawrence and G.H. Snell on various harmful effects on mice.

This chamber has been exposed to the neutrons from our cyclotron simultaneously with our own meters. The result of primary interest is that the special California chamber gave a reading 0.96 as high as the meter which we have been using as an arbitrary standard. We may therefore conclude that our n-unit is substantially the same as that used at Berkeley.

b. Drosophila Survival

Survival curves are now well established for 2-hour Drosophila eggs exposed to (a) 200 kv x-rays and to (b) mixed gamma and fast neutron radiation from the cyclotron. (The reason for using this mixture was that we originally planned the egg exposures as a means of checking back against the results obtained at Berkeley in experiments which likewise involved the total be-D emission.) These curves were surprising from two standpoints: (1) They are distinctly different in shape. The x-ray experimental points fit a 4-hit theoretical curve and the cyclotron points fall nicely on an 8-hit curve, although there is good reason to doubt that the hit theory is adequate for treatment of these data. (This difference in shape of the two survival curves was not noticed in the earlier egg experiments at Berkeley and Ann Arbor, in which the geometry of the arrangement for irradiation with neutrons was rather poor.) (2) The doses for 50 percent survival were 173 r and 47 n, from which follows an X/N dosage ratio of 3.7. The corresponding ratio obtained in earlier work was 2.1. Since our n-unit is substantially the same as that used in the earlier work, it is obvious that we have here an entirely new ratio for 2-hour eggs. This discrepancy is at present ascribed to the fact that the flies used here are of a strain different from that previously used, the latter no longer being obtainable. Such differences in X/N ratios for different strains have been observed before in other species, and it is interesting that we have here discovered another example of this effect, although it is obvious that the eggs have not helped us much in the role of biological dosimeter.

c. Rabbit Survival and Blood Effects

The fast neutron and x-ray survival experiment at the present indicates an X/N dosage ratio of about 7.

Mr. Riley has tabulated the blood data so far available and has begun to analyze them. One analysis, based on a definition of a "survivor" as an animal whose total white count never fell below 2000, yielded rough "survival" curves which indicate an X/N dosage ratio of at least 6 and probably as much as 7, which checks with the current indication of 7 for the corresponding ratio pertaining to lethal action.

No rabbits have been irradiated during the last 10 days because of temporary lack of animals of suitable age. Resumption of irradiation is anticipated within about one week.

10. Hazards From Fission Products - W. E. Cohn

During the past month a number of calculations were carried out relative to the radiation hazards from inhaled or ingested fission products. Due to the proximity of such material to body tissue, and the tendency for it to concentrate in a relatively small volume of tissue (e.g. Sr in bone, I in thyroid), we have here a situation in which beta-radiation is a far more serious hazard than gamma-radiation of equal energy.

Work to date has shown that many of the fission products are very poorly absorbed from the gut into the blood, on the order of 99.9% or more passing out in the feces. In this situation we have to consider the fate of the absorbed fraction and also the irradiation of the gut during passage of the unabsorbed residue. This latter is practically independent of half-period (if $T_{\frac{1}{2}} > 1$ day), but the irradiation due to the internally deposited material (that absorbed less the amount excreted via urine or feces) is not.

The calculation of the absorption of material inhaled into the lungs is complicated in several ways. The extent to which such material will deposit on the lung wall and escape the protective and excretory mechanisms of that organ depend upon particle size, solubility, etc. Following such adsorption or solution at the surface, absorption into the blood will occur to a greater or lesser degree. The laws governing this are not well known. Here again we have to consider the irradiation of the lung by the unabsorbed residue, which, contrary to the case in the gut, is not excreted and can be considered as fixed just as that material in bone is practically permanently fixed.

The maximum intensity of radiation, I, roentgen/day, as a result of Q_d curies of radioactive material with a disintegration energy, E, electro-volts, all the radiation from this source being absorbed in the mass, W, grams, is based on equivalence of energy absorption.

This can be expressed as:

$$\text{r/day} = \text{curies} \times \frac{\text{dis}}{\text{sec.curie}} \times \frac{\text{sec}}{\text{day}} \times \frac{\text{ev}}{\text{dis}} \times \frac{\text{ergs}}{\text{ev}} \times \frac{\text{gm. r}}{\text{erg}} \times \frac{1}{\text{gm}}$$

(1) $$I = Q_d \times 3.7 \times 10^{10} \times 86{,}400 \times E \times 1.6 \times 10^{-12} \times \frac{1}{84} \times \frac{1}{W}$$

$$= 61 \frac{E}{W} Q_d \text{ (intensity in r/day)}$$

The difficulty in applying this simple formula lies principally in assessing the value of W for any particular case. We are also hampered in the calculation of Q_d in those cases for which experimental data are not at hand, for the biochemistry and metabolic characteristics of mosf of the fission products are not known.

In a recent communication (MUC-HG-65) it was pointed out that the maximum (equilibrium) intensity (I_m) that can be achieved in a given tissue as a result of inhaling a radioactive atmosphere of constant activity for 8 hours out of each 24 is given by -

(2) $$I_m = 61\,\frac{E}{W} \times \frac{CVfbd}{\lambda}$$

$$= 3 \times 10^8\,\frac{ECfbd}{W\lambda}$$

C = Curies/cm^3 in air
V = Volume of radioactive air inhaled per 24 hrs. (4.8×10^6 cm^3)

f = fraction of inhaled radioactivity removed by lung (not exhaled)

b = fraction of removed activity absorbed into blood

d = fraction of absorbed material whose radiation is absorbed in tissue of mass W (varies from tissue to tissue)

This also follows directly from (1).

λ is the sum of radioactive decay and biological excretion, in days $^{-1}$.

The maximum dose rate that can be achieved by the unabsorbed residue remaining in the lung is:

(3) $$I_m = 3 \times 10^8\,\frac{ECf(1 - b)}{W\lambda}$$

The constants in equations (2) and (3) which must be evaluated are, principally, f, b, and d. Experimentally it should be possible to measure the products fbd in (2) and f (1 - b) in (3), and plans have been made to do this at X. In the meantime we draw upon what is known about the rates of absorption in the lungs of such materials as iodine, xenon, nicotine, dust particles of various sizes, etc., for an evaluation of f. Measurements of b the absorption, are being made by Hamilton's group (CH-379, CH-498). The deposition of absorbed material, d, will be about the same for material inhaled and absorbed as for material swallowed and absorbed -- it represents the deposition from blood into tissue -- and for its evaluation we can use the data of injection or stomach-tube experiments.

From a period of inhalation which is short compared to the mean life of the isotope involved, the maximum intensity comes at the time when the subject is removed from the radioactive atmosphere, and is given by-

(4) for a tissue $I_m = 3 \times 10^8\,\frac{ECfbd}{W}\,t$

(5) for the lung $I_m = 3 \times 10^8\,\frac{ECf(1 - b)}{W}\,t$

t = time of exposure in days.

The maximum intensity set up in a tissue from the ingestion of a of a source is given by (from (1)) -

(6) $I_m = 61\,\frac{E}{W} \times Q_o\ a\ d$

Q_o = Curies ingested
a = fraction of Q_o absorbed into blood
d = fraction of absorbed material whose radiation is absorbed in tissue of mass W (d varies from tissue to tissue) (see (2)).

The intestinal radiation due to the unabsorbed residue is relatively independent of half-period, so that both intensity (r/day) and total dose (r) are given by -

(7) $I_m = 61 \frac{E}{W} x Q_o (1 - a)$

whereas the total dose following the time of attaining I_m in any other tissue may be derived from the equation

(8) Dose, $D = I_m x \frac{1}{\lambda}$ where λ is as defined above.

The calculations of W, the absorbing mass of tissue, for the cases of lung and intestine are extremely hazardous in view of the complex surfaces of these organs. It may be assumed, in the case of lung, that all beta-radiation originating within this organ is absorbed within it. This follows from a consideration of the relative ranges of beta particles in tissue and in air and from the average thickness of the tissue, which is less than the beta ray-range. However, there is no reason to consider all parts of the lung to be equally radiosensitive; certain types of pulmonary administration may lead to a radioactive concentration in, for example, the lymphatics in the lung area . Such histo-concentration effects may be investigated experimentally with the aid of auto-radiographs.

In the case of the intestine it is not possible safely to assume that all beta-radiation originating within it is absorbed in its walls. Although the surface area of the intestine is extremely large, like that of the lung, in comparison to its size, we do have the possibility of absorption of beta-particles in the fluids between tissue surfaces, and we do have the possibility of loss of beta-particles emitted in a co-axial direction. As a guess we may assume that all the beta radiation is absorbed in the tongue-like villi, covering the surface.

Based on the above considerations, calculations are being made for the tolerable amounts and concentrations of the various fission products that may be inhaled or ingested at any one time or continually over an indefinite period.

11. Hazard from Inhaled I^{131}

The calculations of the previous section have been applied to the problem of iodine in MUC-HG-74,88. An iodine tolerance has been given in MUC-HG-74,88 to Mr. Cooper,on the basis of equation (2) of the preceeding section and the following assumptions.

1) Daily 8 hour exposure
2) Average beta energy, $E = 0.15$ MeV
3) Disintigration constant $\lambda = .089$ day.
4) 20 percent of inhaled iodine deposited in the thyroid, $f = 1$, $C = 1$, $d = 0.2$
5) Thyroid tolerance, $I_m = 1.0$ r/day
6) Thyroid mass, $W = 25$ gm.

The calculated tolerance is then, $C = 2.5 \times 10^{-13}$ curie/ cm^3 for 8 hour daily exposure

D. CLINICAL MEDICINE AND MEDICAL RESEARCH
S. T. Cantril, M.D., Section Chief

12. Medical Control and Accidents

Blood effects due to handling of radium sources appeared in two workers during the past month. The cyclotron was responsible for a third worker with a low blood count.

The hazards of ether were again brought to the fore from an explosion in one of the chemistry laboratories. Three men received first degree burns, two of which necessitated hospitalization, but no permanent damage will be sustained. The combination of an inefficient hood and gas flame in the adjacent hood resulted in explosion. Renewed emphasis is being given to this hazard. An ether extraction of 70 pounds of nitrate done in Mr. Perlman's Group proceeded without accident, but rigid precautions were observed. The radiation hazard of this extraction was reduced to negligible limit by forethought to protection measurements.

We have obtained the part-time services of Mr. Richardson, a Commercial Illustrator, to aid us in preparing posters emphasizing some of the hazards.

13. Toxicology of X metal

Messrs. Wollan and Gamertsfelder have perfected an instrument for analysis of microgram amounts of the metal in tissues after ashing and preparation. The reliability of measurements is sufficiently good to proceed now with autopsy of animals. Studies in animals of the toxicity of uranium oxide and uranyl nitrate by ingestion have been in progress for five months. Skin absorption study of ether extract of uranyl nitrate has been in progress for four months. Subcutaneous injection of uranyl nitrate studies were done on a limited scale and will be continued to form a complete study of uranium deposition, excretion and toxic effects. Inhalation and feeding experiments on dogs have been in progress for four months using powdered uranium metal and oxide.

Future experiments will be directed towards

(a) A complete picture of toxicity by injection experiments, using the nitrate.

(b) Studies of the compounds in most common use (oxide, tetrafluoride, tetra-chloride and metal) to determine the absorption and toxicity by the route of exposure most likely in practice - ingestion, inhalation and skin absorption.

The results of certain of these experiments have already proved useful in appraising the immediate hazard of the ingestion of the oxide and nitrate, and the skin absorption of the ether extract of the nitrate. Further studies will be completed in time to appraise the relative toxicity of other compounds. Animals are kept from each group to ascertain the chronic effects over a long period (maximum for mice 2 years). The results of these experiments will still be useful in appraising any expected toxicity.

14. Tolerance Level for Metal Contamination of Air

No tolerance level has previously been established. The United States Public Health Service has set the tolerance limit for lead contamination in air as 0.15 mg per cubic meter. It seems reasonable to assume that the tolerance for the metal shall not be greater than this. By the use of an electrostatic precipitator and a Dershem Electometer it is possible to measure the alpha-ray activity from a given sample of air and by this means arrive at the concentration of X metal.

Dr. Nickson surveyed the B & T Metals and the H.H.M Safe Co. with special reference to the metal comtamination of the air.

B & T Metals

Measurements of metal in air

3/31/43	- near rolling table and extrusion trough	3.73 mgm/m^3
	- near hearth furnace	1.68 mgm/m^3
4/15/43	- next heating cyclinder on extrusion machine	1.62 mgm/m^3

Measurements show amounts that are from 10 - 20 times the tolerance level. As a result, it was recommended that either an exhaust system be installed, or respirators be worn. At present respirators have been decided upon.

H.H.M.Safe Co.

Measurement of amount of metal in air

4/14/43	- next operation of lathe #238	.55 mgm/m^3
	- air of room at large	.12 mgm/m^3

The first sample is about 3 times the tentative tolerance dose of 0.15 mgm per cubic meter.

These figures would indicate the need for protection of the workers. Protection could be obtained either by the installation of suction systems, or by the use of suitable respirators.

Survey of the radiation exposures in the storage room, where large quantities of the metal were stored, showed that there was no radiation hazard.

15. Hazard of X-Metal from the Point of View of Radioactivity

Parker's measurements of the radioactivity of the X-metal are given in the month's report. His results show that exposure to the hands by penetrating beta-radiation without gloves is of the order of .1 r per hour and that leather gloves cut this down by only 25%. The continuous handling of the metal every day, all day, exceeds our present limits of tolerance for beta-radiation of these energies as this radiation is sufficiently penetrating to reach below the skin.

That no damage has been sustained to date is not evidence that it will not be over a period of years under constant daily handling, 8 hours a day. It is therefore indicated to appraise by careful observation and measurement the amount of radiation which X-metal workers received to the hands. In certain operations the accumulated time of handling throughout the day may exceed that in other operations and ways may be found to reduce actual handling or devise suitable protection.

16. Total Body Radiation of Man

Single exposures of 60 r (400 kv) have been given to four patients with incurable disease. The largest interval of time since the first of these was begun is six weeks. It is hoped that a larger number of patients can be treated. Results cannot be given as yet but are proving of interest and will prove useful in the future.

17. Effect of Vitamin C on Radiation Induced Leukopenia

There is some evidence in the literature that massive administration of Vitamin C has a beneficial effect upon recovery from radiation induced leukopenia. We propose to study this effect in animals. The work will be started when the new experimental laboratory is completed at Chicago (June 1) and approximately 4 months will be required to carry out the study. No additional personnel will be required other than that provided in the new laboratory.

If the results reported in the literature are confirmed, the work will have performed a most useful purpose. We feel that it is essential to study the validity of present claims.

Clinton Laboratories

The Medical organization at Clinton Laboratories and equipment to perform our work there have been planned in detail. The Hematology Laboratory, personnel and equipment have been planned, and the personnel largely secured.

F. RADIATION LABORATORY - U. OF C. BERKELEY, CALIF

Report up to May 5,1943
J. G. Hamilton

1. CERIUM

A large group of rats have been given carrier free Radio-Cerium intraperitoneally, intramuscularly, by mouth, and directly into the lungs. The intraperitoneal animals have been sacrificed at intervals of one, four, eight, sixteen, thirty-two and sixty-four days. The intramuscular groups at one, four, and eight days, the oral group at four days, and the lung group at one, four, eight and sixteen days. No significant absorption by mouth took place. The absorption following intraperitoneal and intramuscular injection was quite irregular. Most of that absorbed by these two routes of administration was found in the liver and skeleton. During the first eight days the uptake was higher in the liver. The data indicates, in my opinion, that Cerium fixed in the skeleton is probably released very slowly. The introduction of Cerium into the lungs revealed that almost one-half was retained in the pulmonary tissue up to sixteen days. The other half which was absorbed was deposited chiefly between the liver and the skeleton. The rate of excretion when injected intraperitoneally averaged approximately 2% per day during the first two weeks of the experiments and by the end of one month it had fallen to less than 1% per day. The digestive tract acted as chief channel of elimination.

2. UNSEPARATED F-PRODUCTS

A large group of rats have received unseparated F-products without carrier which have been freed from X-metal. This material, which has been carefully assayed for its content of the ten most important long life F-products, has been administered by the four different routes that were employed for the Cerium.

At the moment we have data on the intraperitoneal group up to sixteen days. Over this range the content in the skeleton was found to vary from 32% at the first day to 39% on the 16th day. The content of the liver fell from 20% on the first day to 9% on the 16th day, and the unabsorbed balance decreased from 24 to 12% during the same interval. The excretion for this space of time was 23% via the feces and 6.5% by way of the urine. The intramuscular data indicates that the distribution is very similar to that of the intraperitoneal animals. Approximately 4% was absorbed by the gastro-intestinal tract at four days, of which roughly three-fourths was retained in the skeleton suggesting that the absorbed portion was probably made up chiefly of Strontium and Barium. When introduced into the lungs at four days approximately 40% was retained in the pulmonary tissue and most of the absorbed fraction was in the skeleton.

[redacted] [redacted]

[redacted]

3. STRONTIUM

Dr. Chaikoff has now completed his studies with Strontium and the outstanding facts to be secured from his work are the following:

1. The distribution following intraperitoneal injection indicates almost exclusive concentration in the skeleton ranging from 70% at one day to 25% at sixty-four days.

2. Roughly 10% is absorbed by mouth and the absorbed fraction is almost exclusively to be found in the skeleton.

4. DECONTAMINATION STUDIES

At present Professor Greenberg is investigating the protective action of inert Strontium in reducing the uptake of this element into the body. In addition the effectiveness of various removal agents previously listed are being more thoroughly studied.

5. RUTHENIUM

We have now succeeded in preparing Radio-Ruthenium without carrier and free from other radioactive elements. Preliminary experiments indicate that this element is rather poorly absorbed from the peritoneal cavity with a very large proportion of the absorbed fraction going to the liver, and only small amounts deposited in the skeleton.

[redacted]

[redacted]